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THE SOCIAL AND MORAL RESPONSIBILITIES OF
SCIENTISTS AND ENGINEERS

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I am speaking to you tonight on an assigned topic selected by your program committee, The Social and Moral Responsibilities of Scientists and Engineers, i.e. our responsibilities, yours and mine, to our fellow men in the social system in which we live.

The contributions of scientists and engineers to mankind need no defense or apology. Ours is the age of science and engineering. We have harnessed the powers of the physical world around us, steam, electricity, chemical reaction and some nuclear reactions; we have erected towering cities, and conquered barriers of space and time by automobile, train, airplane, spacecraft, telephone, and radio. Through science we have in our country and some others banished the need for drudgery and toil. Exploitation of the physical laws of Nature has brought new marvels of labor-saving devices, automatic factories, rocket airplanes, space capsules, and the like. The weather may be adjusted to suit our needs or whims, perhaps not tomorrow, but some day. New drugs and advances in medical knowledge will further relieve pain and suffering. All of these fruits of tomorrow's science promise to lift burdens and raise the standard of living of all of us.

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The contributions of science have included not only the devising of powerful tools for altering the physical environment of man, but also they have made major contributions to our spiritual life. Science places a high premium on intellectual honesty and on objective truth, truth which can be tested by any man in any age. Science recognizes no arbitrary authority. It does not accept the laws of gravitation because of the authority of Sir Isaac Newton. The laws of gravitation can be observed and demonstrated as a part of anyone's experience. The ethical ideals of the scientist are high. By the efficient tool of the human intellect he has penetrated the mysteries of the material universe and freed the minds of men from ignorance and superstition. The successes of science and their impact on every aspect of life have captured the imagination and loyalties of many men as the only guide to truth.

But science is a partial view of life, in many respects a narrow view. There is often no more naive or gullible individual than the scientist outside his own laboratory and discipline. He tends to develop a myopic vision and to the layman his interest seems to be in details remote from what most people consider the real interests and concerns of life.

Look at an all too common incident of life. A child dashes to the street; there is a shriek of brakes, a cry, and a small body lying in the street. The mother comes running, moaning, wringing her hands, tears streaming from her eyes. How does science describe this event? The physicist may compute the momentum and energy of the car, the forces exerted in the collision, the shock absorbing quality of human tissue, the strength of bones. He may measure the intensity and frequency spectrum of the various sounds, or the rate of generation of tears in the eyes of the mother. The chemist may analyze the tears and reveal the exact proportion of each salt in the water which is their main constituent. He may describe in exact scientific language the fibers of the handkerchief the mother uses to absorb them. The medical specialist may describe the nature of each injury and identify the one which made death inevitable. Surely each of these is an incomplete view though accurate and true. Surely each specialist confining his activities to those of his science misses the larger aspects of the event.

The cold, sharp tools of science have not been effective in penetrating the area of human emotions, purposes, and values. "It is the Nemesis of the struggle for exactitude by the men of sciences" remarked the biologist, Dr. H. S. Jennings, "that leads him to present a mutilated, merely fractional account of the world as a true and complete picture." "You can no more analyze these imponderables by scientific methods" said Eddington, "than you can extract the square root of a sonnet." Science advances by purposely taking a limited and incomplete view of complex events.

Science is not only a partial view of life but it is amoral. There is no moral significance inherent in high explosives, chlorine gas, or nuclear energy. Without high explosives we would not have the plentiful supply of minerals which are the foundation of our civilization. The same high explosives can be used to destroy buildings, bridges, and human beings. Chlorine gas is the basis of common bleaching agents which make possible your white shirts. It is also a potential tool of chemical warfare. An H bomb, releasing the explosive force of millions of tons of TNT along with searing heat and deadly gamma rays and neutrons, can destroy a whole city. Yet the potentialities of nuclear energy for benefit to mankind are as great as its potentialities for destruction. We have only begun to explore its peaceful uses. Certainly an H bomb will not and cannot fall upon us until some member of our human race loads it on an airplane, and until at the right instant some human being pulls the bomb release handle which sends it on its way.

The knowledge obtained in the biological and medical sciences is equally amoral in character. The accomplishments of psychology and psychiatry may be applied for beneficent, selfish, or evil purposes. Modern advertising, and other propaganda, communist brain washing -- all utilize knowledge of human behavior. The knowledge of the causes of disease assists in its cure or in its spread to others. Scientific knowledge is power, but it is power to be used for good or for evil as men choose.

I think that it is this amoral character of science which is the source of unrest of the average man with regard to the scientist and his science. What kind of men and women will control the use to which the great power of science will be put? Will they be creatures of intelligence and understanding? Will they not imagine the consequences of the waging of war with the new A and H weapons and will they not in horror refrain from their use?

The memory of recent history reminds us that the misuse of the products of science for human destruction is not checked by intellectual achievement. The ability of the human mind can be perverted to evil purposes. Perhaps no nation has ever reached such eminence in science and engineering as Germany, but this did not save her from evil leadership. The concern of laymen is with the ideals of men in authority, as well as with their ideas and their intellectual accomplishments.

At a conference on Science and Human Responsibilities A. H. Compton spoke on "Man's Hopes and the New Need for Human Responsibility." He saw much hope for the future of man because man "is a being of spiritual aspiration, of human feeling and emotion." To Dr. Compton "the hope for the longer future lies in a growing understanding of the conditions for the good life of man in a world of science and technology, and the acceptance of a morality that is consistent with these conditions."

I believe that many scientists are now fully awakened to their moral and spiritual responsibilities. As well expressed by Robert Oppenheimer, the scientist has known sin. He has seen his greatest conquest of nature applied to kiloton and megaton bombs to destroy other men. If the scientist fails to take a hand in the decisions, there are many self-confident and ambitious men who are not hampered by too much knowledge and who will not hesitate to make decisions, not on the basis of the scientist's experience or on the basis of moral values, on considerations of right and wrong but on the basis of social and political expediency, or for purely selfish reasons.

I am not one of those few who believe that we can yet abolish the use of force in the world. Its presence is an evidence of our failure, but policemen are still necessary and they must sometimes use force. As a nation we find it necessary to build great military power. I am confident that such strength is a greater contribution to the peace of the world at the present moment than military weakness. Certainly those of our people who fear science most would have been the first to criticize U.S. science if Russia had been the first to develop A bombs.

I think it is clear from what has been said that the social and moral responsibilities of scientists and engineers do not automatically arise from their professional knowledge but from their ethical and spiritual beliefs -- in short, from their religious faith.

A limited and partial knowledge of our physical and spiritual universe is characteristic of every man, whether scientist or not. The areas of knowledge which one can explore in detail and experience for himself even in a lifetime are very few. The knowledge accessible to any man is much greater through the presence of other men with knowledge and experience in other areas. No man could possibly live in the modern world on the knowledge he himself has mastered. He lives by faith in the results of experience of other men, both those now living and those of past generations. His interpretation of the universe, of meaning and value, of moral purpose and his whole philosophy of life are great adventures of faith, extrapolations from all the information at hand to a particular individual. Some are led to a purely materialistic view, and others, including myself, to a belief that in the universe there are the material and the spiritual.

On Sunday I found myself in the morning worship service, for even a scientist needs a religious faith. I had read an article the evening before by a scientist who felt no need for any help beyond the powers of his own mind. He was convinced that the inner life of man--his consciousness of self, his power

of thought, his conscience, his ideals--were the direct result of the physical and chemical activity of the brain. Was this not self-evident, he reasoned, from the fact that damage to the brain destroyed some or all of these manifestations and that drugs could excite or pacify an individual? He believed that in time man could hope to understand and control these physical and chemical processes and thus control his own inner life or the lives of others.

As the memory of his discussion went through my mind, it occurred to me that scientific progress had made us familiar with many realities that are not directly perceived by our own physical senses. I recalled that at that very moment there were present within the room invisible electromagnetic waves from hundreds of radio and television stations carrying voices, music, and pictures from as many distant places. Although I could not at the moment hear or see them, I knew that if a rather complex assemblage of copper, glass, aluminum, and a number of other scarce materials whose very names are unknown to most of us were brought into the room and properly adjusted, any one of these programs could be selected and heard or seen. I knew too that if I damaged the radio or television receiver, the program would disappear; but this certainly did not in any way remove the radio waves from the room nor did it demonstrate that the entire phenomena were produced by the apparatus in the room.

Then my thought returned to my faith that there was also within this room and elsewhere an ever-present spiritual personality whose voice could also be heard by another more complicated assembly of materials, the assembly of carbon, hydrogen, oxygen and other chemicals into that visible object we call a man or woman, made in the image of God. If that physical body were damaged and diseased, the reception might fail; but this does not affect the reality of the invisible spiritual forces.

I was reminded again that science, with its valuable contributions to our material welfare, with its devotion to the search for truth, with its demonstration of the virtues of objectivity in the search for knowledge, was, after all, but a limited and partial view of life.

Most of us in the room are associated with space science and technology and the exploration of space. Perhaps I may be permitted to state a few of the social and moral responsibilities of scientists and engineers working in this field.

(1) To search for knowledge of the facts and to conduct our work with devotion to intellectual honesty and objectivity.

(2) To carry out our part of the national program of space exploration in such a manner as to obtain maximum benefit to the welfare of the nation and all mankind.

(3) As citizens to lend our influence to the establishment of societies of free men in a peaceful world providing not only material benefits but also incentives for mental and spiritual growth and accomplishment.

(4) To realize in our job and daily contacts the highest moral aspirations and ideals of which we are capable.

In conclusion let me depart from the subject to discuss briefly why the nation has undertaken and continues to support the present U.S. space program.

In March of 1958 the President's Science Advisory Committee, of which Dr. James R. Killian, Jr. was then chairman, stated four factors "which give importance, urgency, and inevitability to the advancement of space technology." I will quote them in full.

"The first of these factors is the compelling urge of man to explore and to discover, the thrust of curiosity that leads men to try to go where no one has gone before. Most of the surface of the earth has now been explored and men now turn to the exploration of outer space as their next objective.

"Second, there is the defense objective for the development of space technology. We wish to be sure that space is not used to endanger our security. If space is to be used for military purposes, we must be prepared to use space to defend ourselves.

"Third, there is the factor of national prestige. To be strong and bold in space technology will enhance the prestige of the United States among the peoples of the world and create added confidence in our scientific, technological, industrial, and military strength.

"Fourth, space technology affords new opportunities for scientific observation and experiment which will add to our knowledge and understanding of the earth, the solar system, and the universe."

Space science and technology require research and development at the frontiers of almost every branch of science and technology. Any industrial nation which refuses to devote substantial effort to space exploration is incurring the hazard of future technological obsolescence of its industries, the hazard of potential loss of leadership, and the hazard of military surprise by potential enemies.

There is no question that the rate and scale of the U.S. effort is largely determined by considerations of international policy and the cold war, and possible extension of weapons development to space. But space exploration has major significance for the economic development of the nation far beyond the direct Space Act Congress declared this to be the policy of the United States. Those who are engaged in the work have various motives. Some seek fame, some material profit, some intellectual satisfaction, some a sense of public service. Because of the sum total of all these motivations, the nation continues to support a major effort in space exploration with determination to lead in space science and technology.

We live, in the language of the old cliché, at a great moment in history. Man has begun to lift himself above the restrictions of his planet into a new and strange environment and to expand his intellectual horizons. This is no visionary activity but one essential to the strength and security of our nation and to the future of man in the universe.

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